

IN THE DRAWINGS:

20 Sheets of drawings are in this application.

Figure 7A is currently amended.

All other sheets of drawings remain as previously submitted.

Figure 7A (Currently amended) is replaced with the Figure 7A Replacement Sheet attached to this Reply & Amendment. An Annotated version of the original Figure 7A is also included depicting the changes to this Figure 7A. The change consists of adding additional coolant flow arrows which show that coolant comes in direct contact with the surface (717) of the heat generating component as disclosed in the specification starting at paragraph [0122]. The name and telephone number of the attorney has also been updated.

REMARKS

Applicant has filed this Reply & Amendment responsive to the Office action dated January 22, 2007.

Elections/Restrictions

1. In compliance with the Examiner's requirement for election and consistent with the previous telephone conversation with the Examiner on January 16, 2007, Applicant has cancelled claims 130 – 185 and 218 – 258.

Drawings

2. The Examiner has required a Drawing change depicting "... coolant direct contact with the surfaces of the heat-generating components ..."

3. Applicant believes that Drawings adequately depict direct contact of the coolant with surfaces of the heat-generating components. Nevertheless, Applicant has amended Figure 7A to show additional coolant flow arrows making direct contact with a surface 717 of the packaging of the heat-generating component 702. This does not represent new matter as this is described in detail in the Specification starting at paragraph [0122].

Claim Objections

4. Claim 198 has been objected to by the Examiner for use of the phrase "a dissipater" in line 3 followed by the same phrase in line 4 and for an apparent typographical error in lines 5/6. Applicant has amended claim 198 to address both issues raised by the Examiner and hereby submits that the changes made by Applicant to lines 3, 4 and 5 of this claim overcome the Examiner's objections to this claim.

5. Claim 200 has been objected to by the Examiner for lack of an antecedent basis for “heat exchanger.” Applicant submits that the amendment to claim 200 made herein overcomes the Examiner’s objection to this claim.

Claim Rejections – 35 USC §102

6. Claims 186 – 188, 190, and 193 -197 have been rejected by the Examiner “...under 35 U.S.C. 102(e) as being anticipated by Montgomery et al” (US 6,776,221).

7. Montgomery discloses a closed evaporation loop cooling system that is an entirely different type of system than Applicant’s invention. In Montgomery, heat from the heat-generating component converts the coolant into a vapor and the positioning of the cooled coolant inlets/outlets below the heated vapor inlets and outlets are critical for this invention since Montgomery does not use forced circulation (by means of a pump, etc). See column 3 of Montgomery starting at line 40. Montgomery then completely relies on convective circulation (i.e. warm coolant will rise and cooled coolant will fall) as its sole means of circulating the coolant.

8. In Applicant’s invention, forced circulation by means of pump or other such device is the principal means of circulating the coolant. Convective circulation is used, in addition to forced circulation, as an aid to the forced circulation, particularly after power to the electronic system is shut off. Increased flow rates of the coolant from forced circulation dramatically improve the system’s cooling performance. Applicant’s invention further improves the performance of forced circulation by eliminating the reservoir which requires extra power to circulate coolant through system and which reduces flow rates. It also makes the system appreciably more cost effective and requires less space with the system cabinet/chassis.

9. Applicant has amended independent claims 186 and 194 limiting the claims to forced circulation. Consequently, for the reasons given above in paragraphs 7 & 8, these claims and all claims directly or indirectly dependent on claims 186 and 194 are not anticipated by Montgomery.

Moreover, Applicant's invention, as amended in claims 186 and 194 and all claims that depend thereon, would not be obvious to one skilled in the art in view of Montgomery since they are completely different types of systems. More specifically, Montgomery is not a forced circulation system. Consequently, Applicant submits that the rejection of claims 186 – 188, 190, and 193 -197, as amended herein, in view of Montgomery is overcome and that these claims are now in condition for allowance.

Claim Rejections – 35 USC §103

10. The Examiner has rejected claim 189 "...under 35 U.S.C. 103(a) as being unpatentable over Montgomery et al in view of Koeneman" (US 7,032,392).

11. Since dependent method claim 197 relates to "direct exposure" heat transfer units in a "cooling system having no component acting as a reservoir ...," Applicant assumes that the Examiner inadvertently included claim 197 in his rejection above under 35 U.S.C. 102(e) instead of including it (claim 197) in his rejection under 35 U.S.C. 103(a) of Montgomery in combination with Koeneman. Applicant, consequently, has addressed claim 197 in its comments in the paragraphs immediately following relating to claim 189.

12. Claim 189 is dependent on Claim 186. Claim 197 is dependent on claim 194. Applicant submits that, for the reasons given above, the rejection of claims 186 and 197 as anticipated by Montgomery is overcome. Consequently, Applicant submits that rejection of claims 189 and 197 over Montgomery and in view of Koeneman is also overcome and these claims are now in condition for allowance.

13. Moreover, Applicant submits that Koeneman combined with Montgomery or any other reference would not be obvious with respect to Applicant's claims 189 and 197. Koeneman discloses a heat transfer unit having micro-channels and coolant there through which is embedded within the packaging

of the heat-generating component (e.g. the processor). Consequently, direct contact of the coolant with a surface of heat generating component is to an internal surface. This technique would require a major re-engineering of the heat-generating component at a very substantial cost.

14. Applicant's invention, on the other hand, and as clearly depicted in the drawings (e.g. Figs. 7A, 7B, 8A and 8B) and described in the specification starting at paragraph [0122], relates to thermally coupling a heat transfer unit having one or more open or partially open sides to one or more external surfaces of the heat-generating component. Applicant's invention requires no change at all to the heat-generating component and will result in superior cooling performance because greater flow rates of the coolant are possible.

15. Applicant has amended claims 189 and 197 to make it clear that the coupling of the heat transfer is to external surface(s) of the heat-generating components and that the direct contact of the coolant is with external surface(s) of the heat-generating component(s).

16. Consequently, Applicant submits that, with the amendment to claims 189 and 197, Koeneman by itself or in combination with other art does not anticipate or suggest Applicant's invention as now claimed.

17. Applicant submits that, for all of the reasons given in paragraphs 13-16 above, the rejection of claims 189 and 197 have been overcome and that these claims are in condition for allowance.

18. The Examiner has rejected claims 192 and 193 "under 35 U.S.C. 103(a) as being unpatentable over Montgomery et al."

19. Applicant submits that, since both claims 192 and 193 are dependent upon claim 186 and that since the rejection of claim 186 in view of Montgomery has been overcome above, the rejection of these claims 192 and 193 "over Montgomery" is similarly overcome and these claims are now in condition for allowance.

20. Claims 198, 199, 208-213, 214 and 215 have been rejected by the Examiner "...under 35 U.S.C. 103(a) as being unpatentable over Kang et al" (US 6,144,222).

21. Applicant assumes that the Examiner inadvertently omitted Applicant's dependent method claim 217 in his rejection above under 35 U.S.C. 103(a) in view of Kang and inadvertently included this claim 217 in his rejection under 35 U.S.C. 103(a) in view of Kang in combination with Koeneman. Consequently, Applicant has addressed claim 217 in its remarks immediately following with respect to claims 198, 199, 208 – 215.

22. The Examiner states that Kang discloses "... and the cooling system has no component acting as a reservoir while the cooling system is in operation..." Applicant submits that this statement by the Examiner is incorrect.

23. Kang discloses a heat exchange unit and nothing more. It does not disclose or discuss any other part of the cooling system including coolant transport, circulation, pumps, heat transfer units, etc. Kang consistently throughout (including the title) describes its device as a heat exchange unit. Kang is not a cooling system; it is a component in a cooling system. One cannot infer from Kang that the "cooling system" has no reservoir, since it is silent on the "cooling system" except for the heat exchange unit.

24. Applicant's invention is the elimination of the reservoir in cooling systems of its genre. The prior art for cooling systems of Applicant's genre are what is referred to as 3-piece, liquid cooling systems. The 3 pieces referred to are the heat transfer unit (or cold plate), the heat exchange unit and the reservoir. Typically, the pump is disposed in the reservoir. The coolant transportation mechanism (e.g. conduits, etc.) is not commonly included in the system "piece count". Applicant's invention is the elimination of a piece (i.e. the reservoir") by means of its innovative pump design situated in the output cavity of the heat exchange unit. This invention significantly improves performance by eliminating the reservoir and the negative impact a reservoir has on flow rates; reducing the amount of

coolant required. In a forced circulation cooling system such as Applicant's invention genre, higher flow rates result in significant improved cooling performance and a reservoir will impede flow rates. A reservoir will also have a significant negative effect on any convective circulation that occurs in the system as well. For example, in Applicant's invention convective circulation is used where possible as an enhancement to the forced circulation of the system. This is most useful when a system is powered off (and the pump is no longer working) but the heat-generating component (e.g. a processor) is still generating heat. A reservoir will impede convective circulation. Additionally Applicant's invention results in a significant cost savings and system space requirement (for the reservoir) savings which is of great importance in today's compact electronic systems.

25. In both of Applicant's independent claims 198 and 214 (on which claims 199, 208 -213 and 215 and 217, respectively, directly or indirectly depend), the element clearly states "...in a cooling system (not a heat exchange unit) having no component acting as a reservoir while the cooling system is in operation." Since Kang is silent on the rest of the cooling system and since the prior art for the genre of cooling system was a separate reservoir with a pump, Kang does not anticipate, teach or suggest a "cooling system having no component acting as a reservoir ..." Moreover, it would hardly be obvious to one skilled in the art to employ Kang's heat exchange unit in a "cooling system having no component acting as a reservoir ..."

26. Applicant has amended claim 198 to comply with the Examiner's claim objections. Applicant has also amended claim 214 for consistency.

27. Consequently, with this amendment and for the reasons specified above in paragraphs 22-25, Applicant submits that the Examiner's rejection of claims 198, 199, 208-213, 214, 215 and 217 is overcome and that these claims are in condition for allowance.

28. The Examiner has rejected claims 200 – 207 "...under 35 U.S.C. 103(a) as unpatentable over Kang et al. in view of Roy" (US 6,408,937).

29. Applicant has amended claim 200 to comply with the Examiner's objection for lack of antecedent basis).

30. Applicant submits that, since the Examiner's Rejection of claim 198 over Kang has been overcome, the Examiner's rejection of claims 200 – 207, which depend directly or indirectly on claim 198, is similarly overcome and that these claims are in condition for allowance.

31. Paragraph 30 above notwithstanding, Applicant submits that it would not be obvious to one skilled in the art to combine Roy with Kang. Roy discloses a heat sink (or what is commonly called a heat pipe), not a heat exchange unit. Heat sinks and heat pipes are of a different genre than a liquid cooling system of the type of Applicant's invention or in Kang. In a heat pipe, a heat sink is the primary cooling method and a liquid or gas is used to cool the heat sink. These units are large, cumbersome and not cost-effective. Moreover, the heat must be dissipated right at the heat generating component and inside the system housing or chassis as opposed venting the heat directly out of the chassis by a remote heat exchange unit. Applicant's invention and Roy's are of different genres and it is not obvious nor has it been obvious to combine the elements of the two since they work in very different ways.

32. Additionally as shown throughout the Figures in Roy (see the fluid "F" level indicators), a reservoir is in use. Consequently, combining Roy with Kang would result in a heat exchanger with a reservoir.

33. For the additional reasons stated in paragraphs 31 and 32 above, Applicant further submits that the Examiner's rejection of claims 200-207 is overcome and that these claims are in condition for allowance.

34. The Examiner has rejected claims 216 and 217 "...under 35 U.S.C. 103(a) as being unpatentable over Kang et al. in view of Koeneman."

35. As mentioned above in paragraph 21, Applicant has assumed that claim 217 was inadvertently included by the Examiner in his rejection under 35 U.S.C. 103(a) in view of Kang in combination with Koeneman. Applicant has addressed its remarks to claim 217 in paragraphs 22 - 27 above.

36. Applicant submits that, since the Examiner's rejection of claim 204 on which claim 216 depends has been overcome, the rejection of claim 216 in view of Kang in combination with Koeneman is similarly overcome and claim 216 is in condition for allowance.

37. Moreover, Applicant submits that Koeneman combined with Kang or any other reference would not be obvious with respect to Applicant's claim 216. Koeneman discloses a heat transfer unit having micro-channels and coolant there through which is embedded within the packaging of the heat-generating component (e.g. the processor). Consequently, direct contact of the coolant with a surface of heat generating component is to an internal surface. This technique would require a major re-engineering of the heat-generating component at a very substantial cost.

38. Applicant's invention, on the other hand, and as clearly depicted in the drawings (e.g. Figs. 7A, 7B, 8A and 8B) and described in the specification starting at paragraph [0122], relates to thermally coupling a heat transfer unit having one or more open or partially open sides to one or more external surfaces of the heat-generating component. Applicant's invention requires no change at all to the heat-generating component and will result in superior cooling performance because greater flow rates of the coolant are possible.

39. Applicant has amended claim 216 to make it clear that the coupling of the heat transfer is to external surface(s) of the heat-generating components and that the direct contact of the coolant is with external surface(s) of the heat-generating component(s).

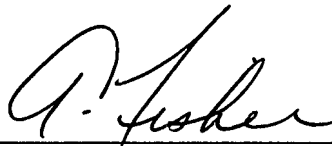
40. Consequently, Applicant submits that, with the amendment to claim 216, Koeneman by itself or in combination with other art does not anticipate or suggest Applicant's invention as now claimed.

41. Applicant submits that, for all of the reasons given in paragraphs 37 - 40 above, the rejection of claim 216 has been overcome and that this claim is in condition for allowance.

Should there be any further comments or issues; the Applicant respectfully invites contact of the undersigned at the telephone number indicated below or at *art.fisher@patentdominion.com*.

Respectfully submitted,

Date: 4/16/2007



Arthur W. Fisher
Registration No. 27,549
Patent Dominion LP
6103 Twin Oaks Circle
Dallas, Texas 75240
(972) 788-1336/office
(972) 788-1335/facsimile

Annotated Sheet

Cooling System
Inventor: Brian A. Hamman
Docket No.: QNX002

Attorney: Arthur W. Fisher
972-788-1336

20 Sheets of Drawings

Attorney Name and
Telephone
Number has
changed

7/20

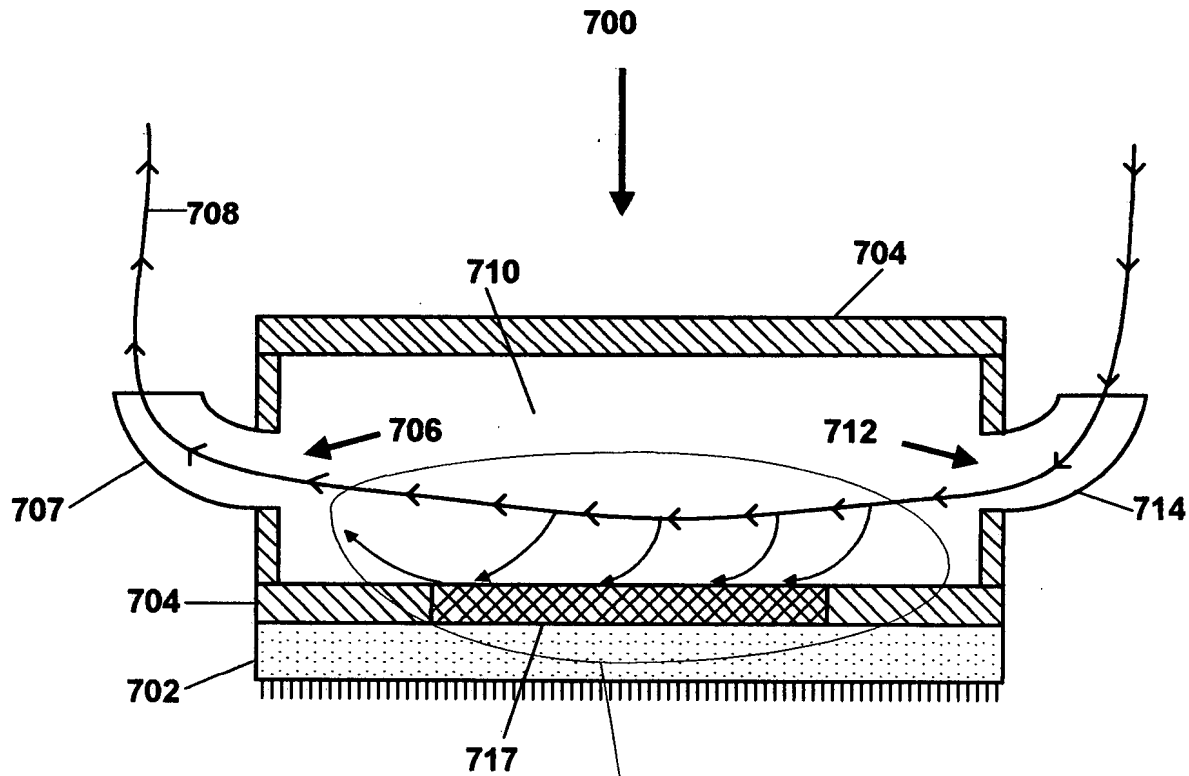


Fig. 7A

Additional coolant flow arrows added